Improved method for preparation of no-carrier added ^{28}Mg tracer

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Magnesium is involved in important physiological activities such as many enzymatic reactions. The isotope ^{28}Mg, which has the longest half-life (21.6 h[1)]) among radioactive magnesium isotopes, is useful in biological sciences as a radioactive tracer.[2,3)] We plan to provide a no-carrier added ^{28}Mg tracer produced in the ^{27}Al(α, 3p) reaction to applicants through, for example the Supply Platform of Short-lived Radioisotopes for Fundamental Research. In a precious paper,[4)] we attempted to separate ^{28}Mg from an Al target, focusing on reducing waste radioactive materials. However, there was an unwanted problem that the obtained tracer contained nuclide ^{7}Be. In this work, we report an improved method for the preparation of no-carrier-added ^{28}Mg tracer in addition to the procedure of beryllium elimination.

Magnesium-28 was produced at either the RIKEN K70 AVF Cyclotron or the AVF Cyclotron at CYRIC, Tohoku University. The target stack of 7 Al foils (99.9% pure) with a thickness of 100 μm was irradiated with an α-particle beam with a beam energy of 50 MeV and a mean current of approximately 3 μA.

First, the conditions for the separation of ^{28}Mg from ^{7}Be were searched for. The irradiated Al targets were dissolved in 12 M (mol/dm^3) HCl. A portion of it, containing 0.1 mmol of Al and trace amounts of ^{7}Be, ^{24}Na, and ^{28}Mg, was heated to dryness and adjusted to 0.5 M oxalic acid. The solution was passed through a cation exchange column (Muromac 50 W×8, 100–200 mesh, 1 mL), which adsorbs Al(III), ^{7}Be,^{24}Na, and ^{28}Mg ions, following which the resin was washed with 7 mL of 0.5 M oxalic acid to eliminate Al(III) and 5 mL of 0.2 M HF. The elution curves of the cation-exchange separation is shown in Fig. 1. The ^{7}Be ions are eluted completely within 5 mL of 0.2 M HF, whereas the ^{24}Na and ^{28}Mg ions are retained onto the column.

Next, the procedure to eliminate ^{7}Be was incorporated into the previous procedure.[4)] The improved chemical scheme is shown in Fig. 2. The irradiated Al targets were dissolved in 9 M HCl and then diluted with water to 15 mL. The ^{28}Mg isotopes were co-precipitated with iron hydroxide by adding 2 mg of Fe(III) and 15 mL of 6 M NaOH and separated from Al, Na, and Be ions. The precipitation of iron hydroxide was dissolved in 9 M HCl. The solution was passed through an anion exchange resin column (Muromac 1×8, 100–200 mesh, 1 mL), which adsorbs Fe(III) ions, and the resin was washed with additional 9 M HCl. The eluate was heated to dryness and adjusted to 0.5 M oxalic acid. The solution was passed through a cation exchange resin column (Muromac 50W×8, 100–200 mesh, 1 mL) to adsorb ^{28}Mg isotopes. The resin was washed with 0.2 M HF for Be elimination, 0.5 M oxalic acid for Al elimination, and 0.5 M HCl for Na elimination. The ^{28}Mg isotopes were eluted from the column with 2 M HCl.

The chemical yield of the separation procedure, determined by γ-spectrometry of ^{28}Mg, was approximately 85% and radioactivity other than ^{28}Mg was not detected in the Mg fraction.

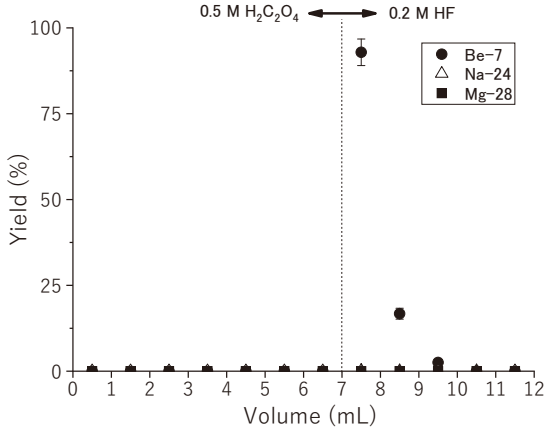

Fig. 1. Elution curves for the cation exchange separation of Be, Na, and Mg.

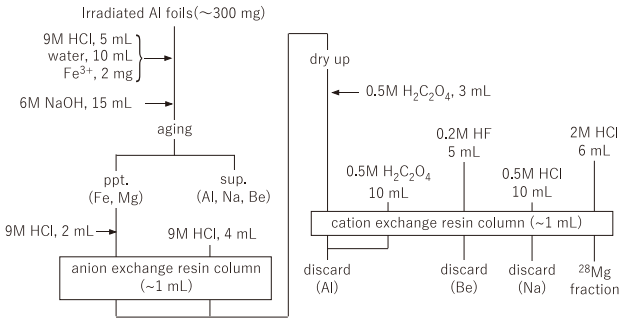

Fig. 2. Chemical procedure for the preparation of no-carrier added ^{28}Mg tracer.

References

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